

would depend upon the quality of the anæsthetic substance used; and it is good to know that steps were taken by systematic chemical analyses to ensure the provision of satisfactory supplies. The remainder of the medical articles examined consisted of phenacetin, "aspirin," and miscellaneous products such as quinine preparations and alkaloids for hypodermal injection or ophthalmic uses.

The constructional activities of our naval and aerial Services are reflected in the report by the remark that 8921 samples examined for the Admiralty consisted largely of metals analysed for the Engineering Department, whilst from the Air Board more than a thousand specimens were sent—chiefly alloys. A sample of a so-called substitute for platinum examined for the Ministry of Munitions proved to be an alloy of nickel, chromium, and tungsten.

In connection with contraband trading, numerous questions were submitted to the laboratory by the War Trade Department, the Foreign Office, the Treasury Solicitor, and the Admiralty Marshal. For the two last-named officials 396 samples were analysed in connection with materials seized as prize, or which were the subject of Prize Court proceedings. They included such varied substances as thorium nitrate (used in making gas mantles), oils, colours, resins, drugs, and soap.

Space does not allow of more than a passing reference to the analyses made for the Board of Agriculture, Home Office, Post Office, Board of Trade, and other Departments. The report shows that a large amount of chemical work, having prime importance for Government administrative requirements, has been accomplished during the period in question.

MAGNETIC OBSERVATIONS DURING A SOLAR ECLIPSE.

THE September issue of *Terrestrial Magnetism and Atmospheric Electricity* is mainly devoted to magnetic observations taken during the total solar eclipse of June 8, 1918. Dr. Bauer, the head of the magnetic department of the Carnegie Institution of Washington, has interested himself in similar work during previous eclipses, and in March, 1918, he issued an appeal for co-operative effort on the occasion of the June eclipse. As a result, observations were taken at a number of stations. Seven of these, in different parts of the United States, were within the belt of totality. There were, besides, eight special field stations in the United States and Canada outside the belt of totality, while observations were taken at twelve ordinary observatories. Dr. Bauer himself observed at Corona, Colorado, a station 11,800 ft. above sea-level.

The general scheme recommended included, in the case of eye readings, observations at one-minute intervals during six consecutive hours, the interval being reduced to thirty seconds at stations within the belt of totality from ten minutes before to ten minutes after totality. In the tables of observational results included single readings are not given, but five-minute means are given for declination at the field stations of the Carnegie Institution. Similar declination data for the field stations of the United States Coast and Geodetic Survey are given in a separate communication by Mr. D. L. Hazard, who also includes readings from the declination, horizontal force, and vertical force curves of the five Coast and Geodetic magnetic observatories. Sir Frederick Stupart deals in another communication with results from Agincourt and Meahook, the two magnetic observatories of the Canadian Meteorological Service, and corresponding results from the magnetic observatory at Antipolo,

Manila, are contributed by the magnetic observer of the Weather Bureau.

A number of the declination results before, during, and after the eclipse are shown graphically on p. 110, forming part of the discussion of the phenomena by Messrs. Bauer, Fisk, and Mauchly. The conclusion of their discussion will presumably appear in the next issue of the journal. The day, though comparatively quiet magnetically, was by no means free from irregular movements. Also North American stations are naturally more disturbed than European stations in the same latitude. Thus the task before Messrs. Bauer, Fisk, and Mauchly of disentangling any eclipse effect from other disturbing effects is scarcely likely to be easy. Observations taken during previous eclipses have shown that the eclipse effect, if there is one, is not large. Thus, unless some trait can be recognised as common to a number of eclipses, it will be difficult to reach any positive conclusion. This doubtless explains why the Department of Terrestrial Magnetism, not content with what has been done during 1918, has already arranged to send two expeditions to places favourable for observations during the ensuing solar eclipse on May 29 next. Those organising similar expeditions are requested to communicate with Dr. Bauer.

Amongst the other contents of the volume there is an interesting comparison by Mr. W. E. W. Jackson of the magnetic declination results obtained during 1917 at Agincourt (Toronto) and the new magnetic observatory at Meanook, Alberta ($54^{\circ} 37' N.$, $113^{\circ} 21' W.$). As might be expected from its geographical position, Meanook is a much more disturbed station than Agincourt. Also, as is common with North American stations, it is much more disturbed than European stations in similar latitudes. The mean absolute diurnal variation was $22.6'$ even in December, and $78.6'$ in August. The regular diurnal variation is analysed by Mr. Jackson in Fourier waves. The wave of twenty-four-hour period is found to have a considerably greater relative importance at Meanook than at Agincourt. The station possesses, in fact, characteristics that recent Antarctic expeditions have shown to exist in high magnetic latitudes. Apparently as yet only declination is recorded at Meanook. It is scarcely necessary to say that the addition of horizontal force and vertical force magnetographs at a station presenting such interesting features is much to be desired.

C. CHREE.

METEOROLOGY AND AVIATION.¹

THE future development of meteorology will almost certainly be closely associated with that of commercial aviation. On one hand, an accurate knowledge of the conditions of wind and weather over a wide area for at least twelve hours in advance will be essential to aerial navigation; while, on the other, aeroplanes provide a means of obtaining information of great value to meteorologists, particularly with regard to clouds.

Clouds are frequently in the form of horizontal sheets, and these are important from the point of view of aerial navigation when they occur at low altitudes. A fairly good example of the upper surface of such a sheet is shown in Fig. 2, but much flatter sheets are sometimes seen. The clouds are caused mainly by the cooling by expansion of water vapour

¹ The accompanying illustrations are from a paper entitled "The Upper Air: Some Impressions Gained by Flying," contributed to the *Journal of the Scottish Meteorological Society* (vol. xviii., No. 35). We are indebted to the society for the loan of the blocks. The photographs and observations were obtained while flying in France in co-operation with the Meteorological Section R.E., and the author is indebted to the Commandant for facilities in obtaining them and for permission to reproduce them.

which is diffused up by innumerable eddies. In the case of low sheets the process of mixing of saturated

adiabatic for saturated air. The majority of cloud-sheets are found under temperature "inversions," where the conditions are most favourable for their persistence. In anti-cyclones large inversions are often found above the clouds, apparently due to the presence of a mass of air which slowly descends and is dynamically heated, but which fails to reach the ground. For instance, near Ipswich on November 14, 1918, the temperature was 29° F. at the top of the clouds at 3000 ft., and rose to 43° F. at 4200 ft., the relative humidity falling to 23 per cent. It seems probable that on these occasions the lower air has been drawn from a cold source and then warmed at the surface during its passage over relatively warm seas, as there is always an adiabatic lapse-rate and a good deal of turbulence under the clouds, which carries up the moisture from below. The inversion damps out the turbulence and prevents the clouds from mixing with



FIG. 1.—A cloud-sheet at 8000 ft.; cumulo-nimbus on the horizon; large anvil, with level top at about 20,000 ft., on the right. Note the false cirrus in front of the sun. 5:20 p.m., September 23, 1918.

air of different temperatures also plays a part, the mixing being carried out by eddies, which are sometimes of a very feeble character and barely perceptible to aeroplanes. Eddy motion is set up by friction with the surface, and usually transmitted to some extent up to about 3000 ft., and sometimes to about 8000 ft., when the air is being heated at the surface. At greater heights eddy motion may be developed throughout a layer 1000 ft. or 2000 ft. thick when the lapse-rate of temperature (vertical temperature gradient) equals the adiabatic rate owing to the intrusion of a cold layer, and if the humidity is high enough clouds may form at the top of the turbulent layer. Sheets of rippled "alto-cumulus" clouds often develop in this way. In order that the clouds may remain in the form of a horizontal sheet, it is important that



FIG. 2.—The clouds of Fig. 1 taken ten minutes later. 5:30 p.m., September 23, 1918.

the dry air above, which would dissolve them entirely. The clouds may persist long after the air has begun

to be cooled at the surface, and travel horizontally for great distances, the air being turbulent just underneath them. In winter they prevent local inland fogs and frost from developing, as they reflect back the radiation from the surface.

In many cases in winter or over the sea accurate forecasts of the height and thickness of the clouds could be made on the assumption that they travel horizontally without change of form. This is true for some cloud-sheets with their lower surface practically on the ground, when the air above them is in a stable condition. On summer days over the land the clouds tend to assume the form of cumulus, but their height and character can often be foretold from the temperature and humidity at different heights.

Figs. 1 and 2 show cumulo-nimbus clouds over the sea which had grown up through a cloud-sheet between 7000 ft. and 8000 ft. There were cumulus clouds from

thunderstorms. Those in the photographs resulted in thunderstorms which reached 20,000 ft., lightning



FIG. 4. Rounded top of a cumulo-nimbus cloud from which a shower is falling. Snow-shower falling from thin high cloud in background. 8 a.m., September 19, 1918.

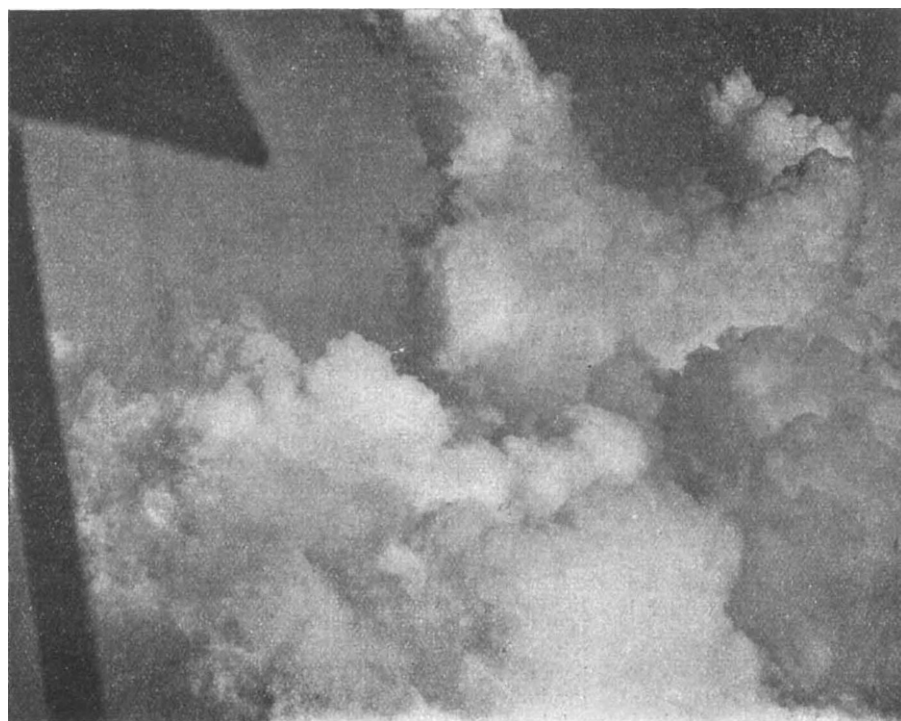


FIG. 3.—Large towering cumuli. 6 p.m., May 17, 1918.

2500 ft. upwards, and some of them grew up through the cloud-sheet and finally developed into showers or

The "false cirrus," of which an example is seen in Figs. 1 and 2, consists of thin snow, which is

being seen after dark. The conditions were unstable, the temperature being 60° at the surface, 49° at 2000 ft., and 6° at 13,000 ft.; the adiabatic for saturated air is $3\frac{1}{2}^{\circ}$ F. per 1000 ft. The lapse-rate just above the cloud-sheet at 8000 ft. was stable enough to allow it to persist for a few hours, except where it was broken through from below. The cumulo-nimbus on the left of Fig. 1 had a very strange form, and had grown larger when Fig. 2 was taken ten minutes later. The clouds moved from W.N.W., but the form of the false cirrus on the top of the cumulo-nimbus gives evidence of the existence of a south-westerly current at 20,000 ft., which possibly caused a slight inversion, and was responsible for the flat top of the distant cumulo-nimbus on the right.

originally developed from supercooled water-drops within the cumulo-nimbus cloud. Sometimes also minute ice-crystals, which sparkle in the sun and cause halo phenomena, are found floating about the tops and edges of showers, occasionally below 10,000 ft. Clouds consisting of supercooled drops cause corona rings, and sometimes also fog-bows.

Fig. 3 shows large towering cumuli over the land on a hot summer evening, with their bases at 5000 ft. and their tops fully 15,000 ft. They were caused by very powerful upward currents developed in the lower atmosphere, where the lapse-rate reached the adiabatic for dry air. The lapse-rate above 6000 ft. was close enough to the adiabatic for saturated air to allow the clouds to tower upwards. They finally broke up without developing into thunderstorms. Fig. 4 shows the rounded top of a cloud extending from 2500 ft. to 10,000 ft., which caused a shower. A powerful upward current in the lower air caused the top to rise until it was colder than the air surrounding it, as frequently happens, but it soon sank down again. The temperature was 54° F. at 2000 ft., 40° at 6000 ft., and 30° at 10,000 ft. The photograph also shows a snow shower falling for 2000 ft. or 3000 ft. from a thin high cloud, and then evaporating, and cirro-stratus clouds at a great height.

Many cloud-sheets develop in layers of high relative humidity as the result of gradual vertical movements over a wide area, which may affect stable layers thousands of feet in depth. These vertical movements are associated with the complex wind system which often exists in the lower atmosphere, due to a complex thermal structure. They remain gradual so long as conditions are stable, but may have important consequences with certain distributions of upper-air temperature and humidity. Sometimes clouds develop at about 6000 ft. or 8000 ft., when the temperature is unusually high at their level and the lapse-rate above them is unstable, so that they ultimately grow to thunderclouds with their tops above 20,000 ft. This process must not be confused with that illustrated by Figs. 1 and 2, when the clouds grow up through a cloud-sheet from a low level.

In the front half of depressions the humidity is sometimes high from a low level up to above 15,000 ft., with either a series of cloud-sheets near together or a thin, ill-defined mist of great depth. Steady rain readily develops from such clouds, but this is unlikely to be heavy unless the conditions are unstable. Favourable conditions for heavy rain occur when there is a cold body of surface air to displace the warm, damp current, and also an unstable lapse-rate of temperature in the upper air, so that the warm air rises bodily and parts with its moisture. The lapse-rate is not necessarily high near the surface; it is clear that with a given surface temperature the possible water-content of the atmosphere is much greater when the temperature is high to about 6000 ft. than when it falls off rapidly from the surface upwards.

An interesting problem on which aeroplane observations throw some light is that of visibility. The present writer has made observations in different places which show that much of the smoke from towns and factories travels for hundreds of miles. In winter it usually lies near the ground, but in summer the convection currents carry it up to 6000 ft., and sometimes to 10,000 ft. If there is an inversion above the haze, the top is sharply defined. A little smoke-haze is sometimes met with at great heights, but it is nearly always possible to see the clouds to the horizon.

Regular observations of temperature and humidity in the upper air at several stations would be of great

value to forecasters. In particular, they should throw light on the minor irregularities which have such an important influence on the weather, and should enable exact short-period forecasts to be made with greater confidence than has hitherto been possible. The accumulation of data as to the upper-air conditions in the various currents which reach our shores should lead to results of far-reaching importance to meteorology.

C. K. M. DOUGLAS.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—A course of three lectures on "The Principles of Palæobotany" will be given at University College by Dr. Marie Stopes on Thursdays, February 27 and March 6 and 13, at 5 p.m. The lectures will be specially adapted to students of botany and geology, but are open to members of the general public who may be interested in them.

OXFORD.—Congregation has lately approved the preamble of a statute putting the professorship of forestry held by Sir William Schlich on a permanent basis. Ever since the transfer, some fourteen years ago, of the Coopers Hill School to Oxford, the study of forestry has continued to assume increasing importance among the studies of the University. This has been in chief measure due to the zealous activity of Sir William Schlich himself, and to the wise co-operation of several of the colleges, notably Magdalen and St. John's. The recent establishment of a new school of agriculture and forestry, supplementary to the former diplomas in those subjects, is an experiment which will be watched with interest, especially as it met with some criticism in its early stages. But there is much reason to believe that the study of these subjects will attain a still higher degree of efficiency than at present.

Congregation will shortly have before it a statute for the reform of Responsions. This measure, if carried in its present form, will have the effect of making either Latin or Greek optional in the examination, and either mathematics or natural science obligatory.

ST. ANDREWS.—The University Court has announced that, under the will of the late Mrs. Purdie, widow of Emeritus Prof. Purdie, the residue of her estate, amounting to about 25,000*l.*, has been bequeathed to the University. This bequest is to be applied exclusively to the promotion of research in chemistry at St. Andrews, and, together with the existing endowment of the chemical research laboratories, places at the disposal of the University a total of approximately 33,000*l.* for the prosecution of original work in this subject. The gift, the terms of which permit of the income being used for the purchase of research equipment and for the foundation of research scholarships, is a fitting close to a long list of benefactions which the chemistry school of St. Andrews owes to the Purdie family.

The development of the chemistry department of the United College as a centre for research is largely due to the efforts of the late Prof. Purdie, and when, in 1893, the accommodation of the laboratories became insufficient, a new laboratory for undergraduates was presented to the University by his aunt, Mrs. Purdie, of Castlecliff. Ten years later Prof. Purdie built and equipped at a cost of about 15,000*l.* a separate institute for chemical research, and as both the University and the Carnegie Trust joined in the scheme, it was possible to create a special